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THE WHITE PINE - OAK FORESTS OF THE ANTHRACITE REGION

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FOREWORD

This paper is a progress report of forest research in the Anthracite Region by personnel of the Station's branch at Kingston, Pa. It is the fifth in a series of seven reports dealing with the principal forest types in the Anthracite Region. The reports completed are:

1. The Northern Hardwood Forests of the Anthracite Region. Station Paper No. 1, issued in March 1947.

2. The Red Oak - White Oak Forests of the Anthracite Region. Station Paper No. 2, issued in May 1947.

3. The Scrub Oak Forests of the Anthracite Region. Station Paper No. 4, issued in June 1947.

4. The Aspen - Gray Birch Forests of the Anthracite Region. Station Paper No. 7, issued in August 1947.

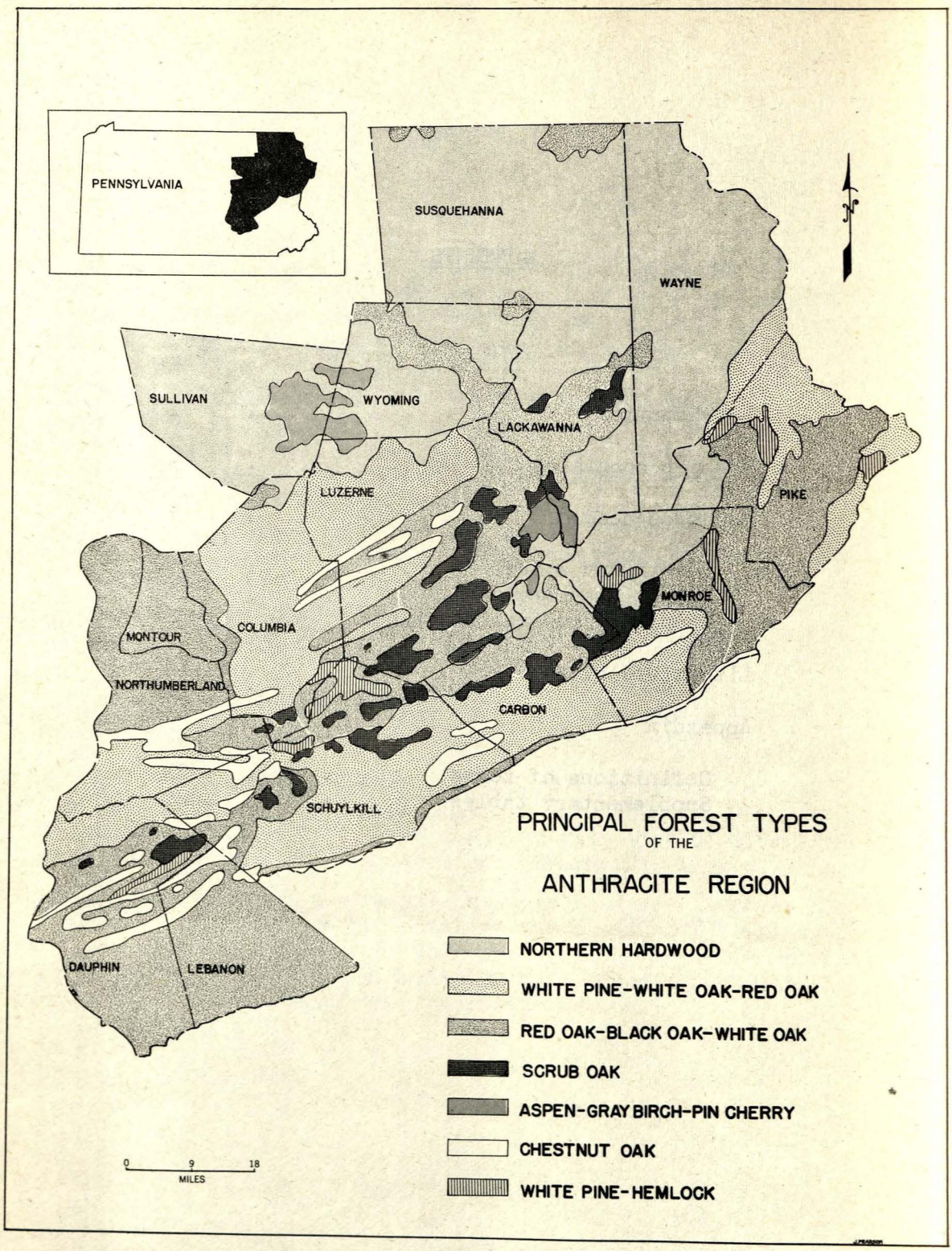
The other reports, which will be issued this year, deal with the white pine - hemlock forests and the chestnut oak forests.

This report presents data on the condition of the forests in the white pine - oak type, and recommendations for improving such forests. The recommendations are only tentative; but they should serve as a useful guide until more precise and refined information is available.

The authors thank the many landowners on whose property the sample plots were established; the personnel of the Industrial Forestry Division of the Wyoming Valley Chamber of Commerce, for their advice and assistance; and the many other individuals who have shown a desire to help solve the forest problems of the Anthracite Region.

CONTENTS

	Page
Introduction	1
Present condition	3
Measures needed	7
Saw-timber stands	9
Pole-timber stands	16
Seedling-and-sapling stands	18
Literature cited	19
Appendix	
Definitions of terms	21
Supplementary tables	24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NORTHUMBERLAND
CARBON
SCHUYLKILL
DAUPHIN
LEBANON
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MILES
PRINCIPAL FOREST TYPES
OF THE
ANTHRACITE REGION
NORTHERN HARDWOOD
WHITE PINE-WHITE OAK-RED OAK
RED OAK-BLACK OAK-WHITE OAK
SCRUB OAK
ASPEN-GRAY BIRCH-PIN CHERRY
CHESTNUT OAK
WHITE PINE-HEMLOCK

THE WHITE PINE -- OAK FORESTS OF THE ANTHRACITE REGION

Their Present Condition and Possible Treatment

By C. F. Burnham
M. J. Ferree
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INTRODUCTION

The white pine - oak forests in the Anthracite Region occupy approximately one-fifth of the forested area.1/ They occur chiefly in the central and southern counties of the region and are characteristic of the fairly fertile agricultural sections in the rolling foothills. Sixty-nine percent are located in these farming areas, another 23 percent are in less accessible forests, and only 8 percent are in the vicinity of the coal fields.

The first people to settle this region (under the Connecticut Charter and the William Penn Grant early in the seventeenth century) must have found some magnificent forests. Timber played an important part in the fortunes of these early settlers. The first timber cut, of course, was used to build cabins, stockades, forts, and other buildings. Timber could not be shipped out because there was no transportation; and when land was cleared for crops some of the timber was cut and burned where it fell. In the middle of the eighteenth century, however, the rafting of shipmast timbers became a profitable enterprise along both the Susquehanna and Delaware Rivers. The tall, straight white pine from the watersheds of these two rivers was in great demand by the coastal shipyards.

Extensive logging did not start until the nineteenth century. Since then the cutting has been so heavy and the subsequent fires so extensive and severe that the white pine - oak forests today are in very poor condition.

These forests still contain a fair amount of white pine, but probably a much lower proportion than was in the original stands. The area occupied by saw-timber stands2/ is very small (table 1) in contrast to the huge area that bears less than 5 cords per acre. The problem

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1/ Ineson, F. A., Ferree, M. J., and Robinson, D. F. The Anthracite Forest Region--a problem area. Northeast. Forest Expt. Sta. 1946. (In process of publication by U. S. Dept. Agr.)

2/ See appendix for definitions.

of getting this large acreage back into production is a tremendous one. It is not beyond solution, but it will take a long time. Methods of speeding up the process are being studied.

The following pages describe the present condition of these white pine - oak stands, and suggest several ways of cutting that, if followed, would constitute the first steps in bringing back some of the fine timber that these forests once contained.

Table 1.--Acreage and volume distribution of the white pine - oak forest type, by stand-size classes[1/]

Item	Saw timber	Pole timber	Unmerchantable[2/] (Seedling and sapling)	All stands
Acres	23,000	95,800	536,500	655,300
Percent	3.5	14.6	81.9	100.0
Sawlog material:				
M bd. ft.	100,900	81,700	197,600	380,200
Percent	26.5	21.5	52.0	100.0
Bd. ft. per acre	4,387	853	368	580
Other material:				
Tons	611,700	1,314,500	3,410,800	5,337,000
Percent	11.5	24.6	63.9	100.0
Tons per acre	26.6	13.7	6.4	8.1
All material:				
M cu. ft.	37,280	62,720	159,610	259,610
Percent	14.4	24.1	61.5	100.0
Cu. ft. per acre	1,621.0	654.7	297.5	396.2

1/ Ineson, F. A., Ferree, M. J., and Robinson, D. F. The Anthracite Region--a problem area. Data are for the entire 15-county area; so percentages and volume-per-acre figures should not be confused with the plot figures that follow.

2/ "Unmerchantable" as used in this table includes saw-timber and pole-timber tracts less than 10 acres in size. The term "seedling and sapling" used elsewhere in this report does not include these tracts.

PRESENT CONDITION

Temporary sample plots were measured in order to determine age, growth rate, mortality, cull factors, stand composition, and possible silvicultural treatments. These plots were distributed equally among saw-timber, pole-timber, and seedling-and-sapling stands on site I and site II. (The white pine - oak type has little acreage on site III.)

Analysis of these measurements disclosed that the white pine - oak forests are similar on both sites (table 2). On site I there is more white pine.3/ In cubic-foot volumes white pine is the leading species, followed in importance by white oak, red oak, and red maple. On site II white oak is most important, followed by white pine, red oak, hickory, and red maple. A large number of other species--white ash, ironwood, aspen, chestnut oak, and black birch--are found on both sites as minor associates.

Stocking and reproduction seem to be ample on both sites. White pine, white oak, red oak, and red maple stems are the most numerous; and in the younger stands there is a higher proportion of red maple. Site I stands have more stems under 4.5 feet high.

The proportion of sprout-origin stems and poorly formed trees is not so great as in red oak - white oak type, but it is high enough to require cutting methods that will lower this percentage--particularly on site II. Red maple produces the greatest number of poorly formed stems on site I, then white oak and red oak. On site II white oak leads in this respect, followed by red maple and red oak. The commercial species that tend to produce sprouts are red maple, chestnut oak, red oak, aspen, and white oak on site I; and white oak, red maple, and red oak on site II.

The seedling-and-sapling stands appear to be more vigorous than either of the other stand-size classes. This is due to wider spacing and relative freedom from crown competition between trees over 3.5 inches d.b.h.

Cull volume on both sites is relatively low except in the site I saw-timber stands. Since these stands are 90 years old, a higher volume of cull is to be expected.

Mortality in trees over 3.6 inches d.b.h. is a minor factor. Over 90 percent of the stems that die naturally are in the 1- to 3-inch d.b.h. class. About one-quarter of these are noncommercial species. Most of the others are red maple, white oak, red oak, and white pine, in that order.

3/ Board-foot volumes of the conifers were computed down to and including the 9-inch d.b.h. class; and the hardwoods were computed down to the 11-inch class. This explains the reversed relationship (table 2) between cubic-foot and board-foot volumes in the younger stands.

Table 2.--Summary of conditions on typical white pine - oak stands

Average Condition	Saw timber		Pole timber		Seedling and sapling	
	Site I	Site II	Site I	Site II	Site I	Site II
Volume per acre ..... Cubic feet..	3529	2002	998	1164	321	264
Tons..	90.5	55.6	27.7	32.3	8.9	7.3
Board feet..	14,173	5907	1090	~~847~~ 947	64	--
Average age .....Years..	90	75	40	54	25	30
Trees per acre						
Pole size (3.6" d.b.h.) and larger.....Number..	206	200	285	315	240	202
Seedling and sapling (0.1-3.5" d.b.h.).....Number..	1048	1036	1158	1303	4365	4508
Reproduction.....Degree.. (under 4.5' high)	Ample	Fair	Ample	Fair	Ample	Ample
Quality .....Percent of total cu.-ft. volume in poorly formed trees	15.2	25.3	23.0	45.2	21.2	29.7
Origin .....Percent of total cu.-ft. volume in sprout-origin trees..	3.7	10.8	19.3	34.1	19.0	18.2
Vigor[1] .....Percent in vigor class 1..	3.9	12.0	10.3	15.3	42.0	32.9
vigor class 2..	22.6	19.1	21.1	23.4	29.6	32.6
vigor class 3..	32.9	43.1	42.3	45.3	23.9	27.5
vigor class 4..	40.6	25.8	26.3	16.0	4.5	7.0
Cull .....Percent of total cu.-ft. volume ..	13.8	4.6	3.1	5.3	2.8	1.9
of total bd.-ft. volume ..	15.3	3.5	0.8	8.6	--	--
Annual mortality.....Cubic feet per acre ..	1.4	1.4	3.2	1.8	0.4	0.0
Percent of total growth ..	2.0	3.1	6.5	3.7	1.3	--
Annual growth[2] .....Cubic feet ... per acre	62	46	45	41	26	22
Tons ...	1.7	1.3	1.3	1.1	0.7	0.6
Board feet ...	350	185	70	60	--	--
Ingrowth.....Percent of annual cu.-ft. increase ...	3.9	2.7	14.1	5.1	63.1	40.9
of annual bd.-ft. increase ...	22.6	24.2	74.2	57.8	100.0	--

1/ For definitions see appendix.
2/ Mortality deducted.

Growth rates are low, comparable to those of the red oak - white oak type. Since the amount of growth depends mostly on the volume of growing stock (until the stand reaches maturity) it is natural for the high-volume plots to show the greatest annual growth (table 3).

Table 3.--Growth in natural white pine - oak stands

Growing stock per acre	Annual growth per acre		Growing stock per acre	Annual growth per acre		Growing stock per acre	Annual growth per acre	
	Site I	Site II		Site I	Site II		Site I	Site II
Cubic feet	Cubic feet	Cubic feet	Tons	Tons	Tons	Board feet	Board feet	Board feet
200	22	21	5.6	0.6	0.6	1000	64	62
400	29	27	11.1	.8	.7	2000	105	97
600	34	32	16.7	1.0	0.9	3000	152	129
800	40	37	22.2	1.2	1.0	4000	200	152
1000	45	40	27.8	1.3	1.1	5000	242	172
1200	50	42	33.8	1.4	1.2	6000	280	189
1400	54	44	38.9	1.5	1.2	7000	310	205
1600	58	45	44.4	1.6	1.2	8000	338	220
1800	61	46	50.0	1.7	1.3	9000	360	230
2000	64	46	55.6	1.8	1.3	10,000	380	230
2200	66	46	61.1	1.8	1.3	11,000	385	230
2400	67	46	66.7	1.9	1.3	12,000	385	227
2600	67	46	72.2	1.9	1.3	13,000	370	--
2800	66	45	77.8	1.8	1.2	14,000	350	--
3000	64	44	83.3	1.8	1.2	15,000	320	--
3200	62	43	88.9	1.7	1.2	--	--	--

Converting factor: 36 cubic feet = 1 ton.

Figure 1.--Saw timber on site I.

MEASURES NEEDED TO IMPROVE PRODUCTIVITY

The white pine - oak forests, which are being seriously depleted by extremely heavy cutting, grazing, and fire, could become one of the most productive forest types in the Anthracite Region. This mixture of valuable conifers and hardwoods has features that make forest management practical. Salient among these are its high yield capacity and its natural resistance to damage from insects, disease, and strong winds. 4/

There is no need for planting, because natural reproduction will be obtained through the silvicultural practices suggested below. However, two general factors must be observed in managing this forest type: grazing by cattle should be prohibited because browsing and trampling prevents a good stand of reproduction; and because white pine is highly vulnerable to fire, protection from fire is particularly important.

The chief silvicultural problem is to increase the ever-dwindling proportion of white pine. In past cutting operations, little consideration was given to regenerating this species. Consequently it gave way to hardwoods because it could not sprout, endure intense shade, or reproduce from seed on thick beds of litter.

The next big problem is to increase the volume and improve the quality of growing stock. The solution: improved cutting methods. These should be designed to remove less volume than is added by growth; to build up the white pine component (10) 5/; and to remove trees of poor form, low quality, and low vigor while holding the better-formed, high-quality, and more vigorous trees until they are mature.

Site quality must be considered in drawing up silvicultural plans for the white pine - oak type. There are great differences in growth rates (table 3) and species composition between site I and site II stands. On site I the proportion of white pine stems decreases as the stand gets older; but on site II the reverse is true. The following tabulation shows this:

Proportion of white pine stems over 3.6 inches d.b.h.

	Site I (Percent)	Site II (Percent)
Saw-timber stands	19.4	18.7
Pole-timber stands	29.4	12.7
Seedling-and-sapling stands	45.0	11.9

This agrees with Frothingham's findings (5), which show that white pine prefers deep, well-drained moist soils but cannot compete with hardwoods for them.

4/ Society of American Foresters. Report of the Committee on Forest Practice, Allegheny Section. 1946. (Mimeographed, 2 pp.)

5/ Figures in parentheses refer to Literature Cited, p.19.

Table 4.--Comparison of four methods of removing low-quality trees from white pine - oak saw-timber stands, site I

(9,000 board feet of low-quality material present)

Year	Item	Clear cut	Heavy cut	Moderate cut	Light cut
		Board feet	Board feet	Board feet	Board feet
	Present volume	15,000	15,000	15,000	15,000
1946	Removal	15,000	9,000****	4,000*	2,100*
	Residual	0	6,000	11,000	12,900
	Expected volume	--	--	--	15,000
1951	Removal	--	--	--	2,100*
	Residual	--	--	--	12,900
	Expected volume	--	9,500	15,000	15,000
1956	Removal	--	8,500***	6,000*	2,100*
	Residual	--	1,000	9,000	12,900
	Expected volume	--	--	--	15,000
1961	Removal	--	--	--	2,100*
	Residual	--	--	--	12,900
	Expected volume	--	--	--	15,000
1966	Removal	--	--	--	2,100*
	Residual	--	--	--	12,900
	Expected volume	--	--	15,000	15,000
1971	Removal	--	--	7,500**	7,500**
	Residual	--	--	7,500	7,500
	Expected volume	--	--	--	--
1976	Removal	--	--	--	--
	Residual	--	--	--	--
	Expected volume	1,000	--	11,500	11,500
1981	Removal	--	--	10,500***	10,500***
	Residual	--	--	1,000	1,000
	Total volume removed	15,000	1/ 17,500	28,000	28,500

1/ Yield for a 10-year period only.
* Improvement cut
** Seed cut
*** Final cut.
**** Improvement and seed cut

SAW-TIMBER STANDS

It is important that proper cutting plans be followed on merchantable areas. The shelterwood system, a partial cutting that allows seedlings to become established under a light overstory of large trees, is recommended for this forest type (8). This method is most suitable because:

1. The present stands are even-aged.

2. The major species will endure only a moderate amount of shade.

3. White pine reproduction will be established because an overstory will check the growth of competing hardwoods, which grow much faster at the start than pine (3) (7).

4. Seedling rather than sprout reproduction of hardwoods will be favored.

5. Conifer windfall and insect damage will be minimized.

Before any system of harvest cutting is used, the stands should be improved by cutting as many low-quality and defective trees as possible. These preliminary improvement cuts are as important as the reproduction cuts.

In applying the improvement cuttings to the white pine - oak sample plots, the saw-timber stands were marked for the removal of 9,000 board feet (51 tons) per acre of low-quality trees on site I (tables 6 and 7), and 3,000 board feet (25 tons) per acre on Site II (tables 8 and 9). Most of these trees marked for cutting were poorly formed or defective white oak, red maple, yellow and black birch, hickory, and white ash; and to a lesser extent, white pine, elm, and ironwood. All of this material could be sold as mine timbers.

Four different intensities of cutting were studied: clear-cutting, a heavy cut, a moderate cut, and a light cut. Tables 4 and 5 indicate what may be expected from these various intensities of improvement cutting. Growth rates for natural stands (table 3) were used in computing the volumes. Work done by Hough and Taylor (6) in northwestern Pennsylvania and by Moore (10) in New Jersey indicate that growth rates will increase when stands are partially cut. In view of this, the growth rates were increased 10 percent on site I and 8 percent on site II in estimating the residual stands. The amount of annual growth is low in the very young stands (table 2). Older stands growing naturally have a period of fast growth before they culminate at 11,000 and 9,000 board feet per acre on sites I and II respectively. This period of rapid growth, which is due to the white pine in the stands, is confirmed by the findings of Kittredge and Chittenden (7). In computing growth rates for partially-cut managed stands it is assumed that this culmination point will be 15,000 and 12,000 board feet per acre on sites I and II.

Table 5.--Comparison of four methods of removing low-quality trees from white pine - oak saw-timber stands, site II

(3,000 board feet of low-quality material present)

Year	Item	Clear cut	Heavy cut	Moderate cut	Light cut
		Board feet	Board feet	Board feet	Board feet
	Present volume	7,000	7,000	7,000	7,000
1946	Removal	7,000	3,000*	1,500*	400*
	Residual	0	4,000	5,500	6,600
	Expected volume	--	--	--	7,650
1951	Removal	--	--	--	400*
	Residual	--	--	--	7,250
	Expected volume	--	--	--	8,350
1956	Removal	--	--	--	400*
	Residual	--	--	--	7,950
	Expected volume	--	--	8,700	9,150
1961	Removal	--	--	1,700*	500*
	Residual	--	--	7,000	8,650
	Expected volume	--	--	--	9,850
1966	Removal	--	--	--	500*
	Residual	--	--	--	9,350
	Expected volume	--	--	--	10,600
1971	Removal	--	--	--	500*
	Residual	--	--	--	10,100
	Expected volume	--	--	--	11,350
1976	Removal	--	--	--	600*
	Residual	--	--	--	10,750
	Expected volume	--	12,000	12,000	12,000
1981	Removal	--	6,000**	6,000**	6,000**
	Residual	--	6,000	6,000	6,000
	Expected volume	--	--	--	--
1986	Removal	--	--	--	--
	Residual	--	--	--	--
	Expected volume	1,400	8,200	8,200	8,200
1991	Removal	--	7,200***	7,200***	7,200***
	Residual	--	1,000	1,000	1,000
	Total volume removed	7,000	16,200 1/	16,400	16,500

1/ Yield for a 10-year period only.
* Improvement cut.
** Seed cut.
*** Final cut.

Clear cutting.--The present practice of cutting all trees down to 2 inches d.b.h. should be discontinued. It yields considerably less volume over a given number of years (tables 4 and 5) and a greater proportion of low-quality material than any of the partial-cutting methods (9). Growing conditions for future stands are greatly hampered, because:

1. Sprout reproduction is encouraged, and white pine will completely disappear from the stands.

2. The fire hazard is increased because of the large amounts of slash left after logging.

3. The site is exposed so that soil erosion and soil drying-out is severe.

4. The proportion of intolerant, non-commercial species such as ironwood, fire cherry, aspen, and gray birch will increase.

5. It favors attacks of gypsy moth and other destructive insect pests.[6/]

6. Dense briar, grass, or ferns may grow so thickly that they will retard the establishment of good tree species for many years. This is particularly true when very old stands are clear-cut and stump sprouting does not occur.

The heavy cut.--This will remove all the low-quality trees in one cut on the site I stand (table 4). Although it is designed primarily as an improvement cut, it will serve also as a seed cut (12). The logging should break up the litter on the forest floor and prepare a mineral seedbed that is usually necessary for the establishment of white pine seedlings.[7/] Since this stand is already mature, the removal of 9,000 board feet of low-quality trees should be made when the white pines and oaks have a good seed year; this can be determined by observing the number of cones and acorns on the seed trees. In the seed cut, large, well-spaced, seed-bearing trees of high quality should be left to ensure reproduction. These also protect the seedlings while they are getting started. Ten years later the final cut should be made. This will take the seed trees. Cleanings to remove inferior, competing young growth should follow. The first one should be made 3 to 8 years after the final cut. One or two subsequent cleanings, if needed, should be made at 5-year intervals thereafter (3). During the final cleaning, small white pine crop trees should be pruned, removing not more than one-third of the living crown.[8/]

6/ Bess, Henry A., Spurr, Stephen H., and Littlefield, E. W. Forest Site Conditions and the Gypsy Moth. 1945. (Unpublished manuscript. Harvard Forest.)

7/ Baker, W. M. Comments on timber stand improvement in the Central States. Central States Expt. Sta. Note 30. 1936.

8/ Helmer, A. E. How heavy should white pine be pruned? North. Rocky Mt. Range and Expt. Sta. Res. Note 41. 1946.

Figure 2.--Saw timber on site II.

Since the site II average stand (table 5) has not reached maturity, the improvement cut will not serve as the seed cut. Instead, all of the low-quality material (3,000 board feet per acre) will be removed in one operation and the stand will be allowed to grow. In 35 years it should attain the maturity volume of 12,000 board feet per acre. Then the seed cut should be made, followed by the final cut 10 years later. Cleanings should be made when necessary in order to control the hardwood species.

The heavy cut method is recommended for less accessible forest areas where large volumes are necessary to meet high logging costs.

The moderate cut.--This method removes the low-quality trees in two operations. These first two improvement cuts will help prepare the forest floor for regeneration, and will release tree crowns so that they may bear heavy crops of seed. It is also likely that a considerable amount of reproduction will become established after each cut. The first cuts will remove 4,000 board feet per acre and 1,500 board feet per acre of the low-quality material on sites I and II respectively. Ten years later on site I and 15 years later on site II the second improvement cuts should be made, removing 6,000 and 1,700 board feet per acre on these sites. Then in 15 years on site I and 20 years on site II, when the maturity volumes have been reached, the seed cuts should be made, followed by the final cuts as outlined for the heavy-cut method. Cleanings will be necessary. This type of cutting is recommended for either farm forests or extensive forests wherever logging costs do not demand a large volume.

The light cut.--This method is designed to remove the low-quality trees in a series of light cuts made at 5-year intervals. It is recommended for farm woodlot owners who can find time to do their own woods work during months when farm work is slack. In the average site I stand five cuts, each removing 2,100 board feet per acre, should be made. These should be followed by the seed and final cuts (table 4). In the average site II stand seven very light cuts are required to remove the low-quality trees and to build the amount of growing stock up to maturity (table 5). The seed and final cuts should be made when the stand has reached a volume of 12,000 board feet per acre. These light operations may not result in the establishment of much white pine reproduction, since the species is rather intolerant of shade. The final seed cut will be relied upon for most of the regeneration.

The light-cutting method requires more skillful treatment than any of the other methods, but it has several advantages. It offers more frequent cash returns; a woodlot owner can be fairly sure of a continued annual return if he properly distributes his cutting over the entire tract. In addition, it yields higher-quality lumber.9/

9/ Lake States Forest Experiment Station. Light cuttings in hardwoods show high quality increase. Lake States Forest Expt. Sta. Tech. Note 166. 1940.

Any one of the above methods of cutting can be used to remove the low-quality trees from a stand and to prepare it for the reproduction cut in the shelterwood system. The quantities shown in tables 4 and 5 apply only to the typical stands found in this study, but the same procedure can be applied to any fairly well stocked stand. Selection of the method to use on any given area should be based on careful appraisal of economic and silvicultural factors. Tables 4 and 5 show that about 1,000 board feet per acre will be left after each final cut. After 30 or 40 years this volume will have increased to a point where the second rotation can be started. In the meantime stand-improvement cuttings should be used to eliminate undesirable species where they persist. The second rotation should produce higher quality trees and consequently higher financial returns. Cutting plans should be kept flexible so that all cutting and timber use can be constantly checked with market conditions and demands.

Figure 3.--Pole timber on site I.

Figure 4 --Pole timber on site II.

POLE-TIMBER STANDS

The sample plots in pole-timber stands (tables 10-13) were marked for the removal of deformed and defective trees. The cut came to 49 cubic feet (1.25 tons) per acre on site I, and 126 cubic feet (3.5 tons) on site II. Most of the trees were hold-overs from the last logging--big, slow-growing red maples, white pines, and red and white oaks. Such trees must come out so the space can be taken by young, fast-growing, high-quality stems.10/ In some stands they may contain too much rot to sell, or may be in such position that felling them will damage many young trees. Then they should be girdled (1).

The average stand is not dense (tables 10-13), but light thinnings should be made each time an improvement cutting is made. The white pine poles selected for the final crop should be pruned, but at least two-thirds of the crown should be left. Thinning of young white pine will stimulate its growth (8). White pine in the intermediate or suppressed-crown classes should not be released fully in one operation, because wind breakage or sun scald may result (8).

10/ Condit, G. R., Huberman, M. A., McGuire, J. R. Collect the bounty on your wolf trees. Northeast. Forest Expt. Sta. Tech. Note 45. 1941.

Figure 5.--Seedlings and saplings on site I.

Figure 6.--Seedlings and saplings on site II.

SEEDLING-AND-SAPLING STANDS

More than half the stems less than 3.6 inches d.b.h. in the average seedling-and-sapling stand on site I (tables 14 and 15) are weeds--shadbush, sassafras, blue beech, ironwood, thornapple, and witch hazel. There are fewer of these weeds on site II (tables 16 and 17). Of the commercial species, sprouts and poorly formed trees make up a quarter of the cubic volume.

The only way to improve these stands is to get rid of the weed species and the poor-quality trees. The best time to do this is while the stands are below pole size (11). This cleaning-up can be most effective if done in summer, because hardwood stumps sprout the least after summer cuttings (2).

On the heavy soils of site I, such cleanings will be needed if white pine is to grow. Otherwise hardwood sprouts will crowd them out (5). It may take several cleanings--probably at 5-year intervals (4)--to bring through the stand wanted. Cline (3) says one to three cleanings are needed, requiring 12 to 30 man-hours per acre. The third cleaning probably will produce enough fuel wood or mine lagging to pay the costs.

On the lighter soils of site II the pines have a better chance to survive the competition from hardwoods. Fewer cleanings will be needed. Although these cleanings usually yield no immediate return, they do improve the stand composition; and growth is put on high-quality trees, so that increased dividends will be realized from later cuts.

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APPENDIX

DEFINITIONS OF TERMS

The terms used in this report are defined below.

Forest Sites

Site I.--This site is characterized by moist, well-drained, fairly deep soils frequently of alluvial origin. It usually is found in protected coves or along streams or bottom-lands that are moist and well-drained throughout the year. On northern exposures it usually extends higher up the slope than on southern exposures because of more soil moisture. Club moss, hydrangea, maidenhair fern, trillium, sphagnum moss, and fern-leaf moss are fairly good indicators. Yellow poplar, black cherry, yellow and black birch are often present.

In mature stands the dominant and co-dominant hardwoods will produce 3 or more 16-foot logs per tree. Conifer dominants and co-dominants will produce $3\frac{1}{2}$ or more 16-foot logs.

Site II.--Site II areas are characterized by soils intermediate in moisture, depth, drainage, and fertility. They dry out only for short periods during the year. Usually they are slope types located between the ridges and the coves or bottom-lands. Poorly drained bottom-lands may be of site II quality. Ordinarily the site reaches nearly to the ridge tops. It reaches higher on slopes with northern exposures than on slopes with southern exposures. Trailing arbutus, ground pine, aster, goldenrod, bracken fern, and sheep laurel usually indicate Site II. Chestnut oak, black oak, and hickory are often present.

In mature stands the dominant and co-dominant hardwoods will make $2-2\frac{1}{2}$ 16-foot logs per tree. The conifers will yield $2\frac{1}{2}-3$ 16-foot logs.

Site III.--This site is characterized by shallow, rather dry, stony or compact soils characteristic of ridges. It will produce hardwood trees having less than 2 16-foot logs per tree at maturity. On southern exposures it may extend down a slope for some distance, because of lack of soil moisture. Dense thickets of mountain laurel or an abundance of lichens often indicate site III.

Forest Stand-size Classes

Saw-timber stands.--Stands having a minimum volume of 2,000 board feet per acre are classed as saw-timber stands. Saw-timber volume is measured in conifers in the 9-inch d.b.h. class and over, and in hardwoods in the 11-inch d.b.h. class and over.

Pole-timber stands.--These are stands having a minimum volume of 5 standard cords per acre in the 4-inch d.b.h. class and over, and less than 2,000 board feet of saw-timber.

Seedling-and-sapling stands.--These are young-growth stands that have less than 5 standard cords of wood per acre in trees in the 4-inch d.b.h. class and over.

Tree Vigor Classification

In this study tree vigor is an expression of the present relative growth rate of a tree as conditioned by density, size, and position of the crown plus the general health of the tree as determined from its age and the presence or absence of diseases or mechanical injuries. Four vigor classes are recognized.

Vigor class 1.--Trees in this class have large dense crowns. Usually they are dominant or co-dominant with at least one-half of their crowns exposed. They are free from diseases or mechanical breakage tending to reduce the crown surface. (Small mechanical injuries on tree trunks do not affect the vigor classification.) They are free from old age stagnation as evidenced by dead limbs in the crown, and have a general healthy and thrifty appearance.

Vigor class 2.--Trees in this class have a fair-sized crown with moderate density or a large crown of light density. They are usually co-dominant with less than one-half the crown exposed, but with more than the tip in the open in well-stocked uncut stands. They are free from diseases or mechanical breakage tending to reduce the crown surface, and are free from old-age stagnation. They may be trees that are dropped from vigor class 1 because of injury, disease, or old age.

Vigor class 3.--Trees in this class have small dense crowns with only the tips exposed and are free from diseases and mechanical injuries tending to reduce crown surface. They have not reached old-age stagnation. They may be trees that are dropped from vigor classes 1 or 2 because of injury, disease, or old age.

Vigor class 4.--Trees in this class are growing under obvious handicaps, such as severe suppression, injury, disease, or old age.

Tree Origin

Seedling.--Any tree that at present shows no union with a stump or other tree and can be silviculturally treated as a single tree.

Sprout.--Any tree that is joined to a stump, other tree, or clump of trees.

Tree Form

Good form.--Any tree that at present has a clear, straight bole and is a potential saw-timber tree.

Poor form.--Any tree that at present is so deformed that its potential use would not exceed that of mine props.

Other Terms

Ingrowth.--Volume of small-sized trees that have grown into the merchantable classes during the past 10 years.

Mortality.--Number and/or volume of trees that have been lost through natural causes such as insects, windfall, disease, or suppression during the past 10 years.

Table 6.--Site I, saw timber: Number of trees per acre, by species and diameter

D.b.h. (inches)	White pine	Hemlock	Red oak	White oak	Hickory	Red maple	Beech	Yellow birch	Gray birch	White ash	Misc.[1]	Total	Percent
1	40	--	53	159	16	211	--	5	--	24	211	719	68.6
2	8	5	8	88	--	68	--	15	--	--	45	237	22.6
3	21	5	--	24	--	21	--	8	--	--	13	92	8.8
Total	69	10	61	271	16	300	--	28	--	24	269	1048	100.0
Percent	6.6	0.9	5.8	25.8	1.5	28.7	--	2.7	--	2.3	25.7	100.0	--
4	2.7	1.6	0.4	6.4	--	17.1	0.4	1.6	2.7	0.5	11.7	45.1	21.9
5	3.1	2.6	.5	7.5	0.5	8.9	.5	.5	.5	1.8	3.1	29.5	14.4
6	2.0	4.1	.9	4.6	.5	5.8	.4	1.6	--	.4	1.0	21.3	10.4
7	3.0	2.0	--	2.7	.5	3.8	.4	.5	.5	.5	1.5	15.4	7.4
8	3.2	--	--	4.8	--	4.2	--	--	--	.5	--	12.7	6.1
9	2.6	.5	--	4.7	--	1.6	--	.5	.5	--	--	10.4	5.0
10	2.5	--	--	4.2	.5	1.5	--	--	--	--	1.1	9.8	4.7
11	2.5	--	1.6	6.7	--	.5	--	1.1	--	--	--	12.4	6.0
12	2.0	.5	.5	2.9	.5	1.0	--	--	--	--	--	7.4	3.6
13	2.0	1.0	--	4.0	.5	.9	--	--	--	--	--	8.4	4.1
14	2.0	.5	--	.4	--	--	--	--	--	--	--	2.9	1.4
15	1.4	--	.5	2.4	--	--	--	--	--	--	--	4.3	2.1
16	1.5	--	--	2.4	--	--	--	--	--	--	--	3.9	1.9
17	1.0	--	1.6	1.9	--	--	--	--	--	.4	--	4.9	2.4
18	1.6	--	1.1	--	--	--	--	--	--	--	--	2.7	1.3
19	1.6	--	.5	1.9	--	--	--	--	--	--	--	4.0	1.9
20	--	--	1.6	1.0	--	--	--	--	--	--	--	2.6	1.3
21	2.1	--	.5	.4	--	--	--	--	--	--	--	3.0	1.4
22	.5	--	--	1.0	--	--	--	--	--	--	--	1.5	.7
23	1.6	--	--	.5	--	--	--	--	--	--	--	2.1	1.0
24	.5	--	--	--	--	--	--	--	--	--	--	.5	.2
25	.5	--	--	--	--	--	--	--	--	--	--	.5	.2
26	--	--	--	--	--	--	--	--	--	.4	--	.4	.2
30	--	--	.4	--	--	--	--	--	--	--	--	.4	.2
31	--	--	.4	--	--	--	--	--	--	--	--	.4	.2
Total	39.9	12.8	10.5	60.4	3.0	45.3	1.7	5.8	4.2	4.5	18.4	206.5	100.0
Percent	19.4	6.2	5.1	29.3	1.4	21.9	0.8	2.8	2.0	2.2	8.9	100.0	--

1/ Includes noncommercial species (blue beech, fire cherry, shadbush, ironwood, chestnut) totaling 240 stems under 4 inches d.b.h. and 12.4 stems over 4 inches d.b.h.; and commercial species (pitch pine, chestnut oak, black birch, basswood, yellow poplar, black cherry, aspen) totaling 29 stems under 4 inches d.b.h. and 6.0 stems over 4 inches d.b.h.

Table 7.--Site I saw timber: Volume per acre, by species and diameter and by tree form[1/]

Item	Poor form	Good form	Total		Poor form	Good form	Total	
	Cubic feet	Cubic feet	Cubic feet	Per-cent	Board feet	Board feet	Board feet	Per-cent
Species:								
White pine	15.9	1199.5	1215.4	37.3	42	6132	6174	43.7
Hemlock	1.9	67.6	69.5	2.1	--	245	245	1.7
Red oak	.6	523.5	524.1	16.1	--	2601	2601	18.3
White oak	311.8	776.3	1088.1	33.4	1000	3381	4381	30.8
Hickory	10.6	22.6	33.2	1.0	38	49	87	.6
Red maple	105.9	59.4	165.3	5.1	39	156	195	1.4
Beech	.2	3.4	3.6	.1	--	--	--	--
Yellow birch	29.8	.2	30.0	.9	56	--	56	.4
Gray birch	9.1	--	9.1	.3	--	--	--	--
White ash	1.7	83.5	85.2	2.6	--	434	434	3.1
Miscellaneous[2/]	9.3	26.4	35.7	1.1	--	--	--	--
Total	496.8	2762.4	3259.2	100.0	1175	12998	14173	100.0
D.b.h.: (Inches)								
4	17.3	5.8	23.1	0.7	--	--	--	--
5	25.8	18.1	43.9	1.3	--	--	--	--
6	26.5	32.7	59.2	1.8	--	--	--	--
7	32.3	40.7	73.0	2.2	--	--	--	--
8	51.2	44.2	95.4	3.0	--	--	--	--
9	51.2	49.8	101.0	3.1	16	77	93	0.6
10	44.3	84.7	129.0	4.0	26	104	130	.8
11	51.3	152.9	204.2	6.3	174	551	725	5.1
12	44.9	104.6	149.5	4.6	177	438	615	4.4
13	38.9	168.2	207.1	6.4	158	745	903	6.3
14	--	91.2	91.2	2.3	--	448	448	3.2
15	--	155.0	155.0	4.8	--	607	607	4.3
16	20.5	145.1	165.6	5 0	101	753	854	6.0
17	--	236.4	236.4	7.3	--	1228	1228	8.7
18	--	152.6	152.6	4.8	--	836	836	5.9
19	--	256.1	256.1	8.0	--	1426	1426	10.1
20	--	182.2	182.2	5.7	--	968	968	6.8
21	--	248.3	248.3	7.7	--	1428	1428	10.1
22	44.0	91.3	135.3	4.1	248	526	774	5.5
23	48.6	168.2	216 8	6.6	275	992	1267	9.0
24	--	58.7	58.7	1.8	--	344	344	2.4
25	--	65.2	65.2	2.0	--	377	377	2.7
26	--	54.8	54.8	1.7	--	327	327	2.3
30	--	74.8	74.8	2.3	--	396	396	2.8
31	--	80.8	80.8	2.5	--	427	427	3.0
Total	496.8	2762.4	3259.2	100.0	1175	12998	14173	100.0
Percent	15.2	84.8	100.0	--	8.3	91.7	100.0	--

1/ Burnham, C. F., Ferrec, M. J. and Cunningham, F. E. Site class volume tables for merchantable timber in the Anthracite Region of Pennsylvania. Northeast. Forest Expt. Sta. Forest Management Paper 3. 1946.

2/ Includes noncommercial species (blue beech, fire cherry, shadbush, and ironwood) and commercial species (pitch pine, chestnut oak, black birch, basswood, yellow poplar, black cherry, and aspen).

Table 8.--Site II, saw timber: Number of trees per acre, by species and diameter

D.b.h. (Inches)	White pine	Hemlock	Red oak	White oak	Chestnut oak	Hickory	Sugar maple	Red maple	White ash	Elm	Misc.[1/]	Total	Percent
1	26	--	43	22	--	28	35	232	42	20	351	799	77.1
2	31	--	5	--	--	--	5	47	--	10	104	202	19.5
3	--	--	5	--	--	--	--	12	--	--	18	35	3.4
Total	57	--	53	22	--	28	40	291	42	30	473	1036	100.0
Percent	5.5	--	5.1	2.1	--	2.7	3.9	28.1	4.0	2.9	45.7	100.0	--
4	5.0	1.3	3.9	2.9	0.8	1.3	0.8	3.9	3.5	--	14.3	37.7	18.9
5	3.6	.5	2.6	4.6	--	1.6	.8	5.3	2.1	1.0	8.0	30.1	15.1
6	2.5	1.0	1.3	4.0	1.3	2.3	1.3	3.1	3.1	--	4.8	24.7	12.4
7	3.8	.3	.5	6.1	.5	.5	.5	1.4	1.0	--	3.2	17 8	8.9
8	2.8	.5	1.3	4.5	.8	.8	--	.8	.5	--	1.0	13.0	6.5
9	2.1	.5	3.7	4.6	--	.5	--	.3	1.0	--	--	12.7	6.4
10	1.0		2.6	4.2	.5	.8	--	.6	--	--	1.0	10.7	5.4
11	3.1	.5	1.8	6.8	--	1.3	--	.3	.5	.5	--	14.8	7.4
12	3.1	--	1.4	2.7	--	--	--	--	--	.5	--	7.7	3.9
13	2.1	--	.3	4.0	--	--	--	--	--	--	.5	6.9	3.5
14	.6	--	--	2.0	--	--	--	--	.5	--	--	3.1	1.5
15	2.2	.5	1.1	2.3	--	--	--	--	--	--	--	6.1	3.1
16	1.6	--	.6	2.3	--	--	--	--	--	.5	--	5.0	2.5
17	1.3	--	.6	.6	--	--	--	--	--	--	--	2.5	1.2
18	--	--	1.0	1.2	--	--	--	--	--	--	--	2.2	1.1
19	1.4	--	.3	.6	--	--	--	--	--	--	--	2.3	1.1
20	.3	--	.3	--	--	--	--	--	--	--	--	.6	.3
21	.5	--	--	--	--	--	--	--	--	--	--	.5	.2
22	.3	--	--	.3	--	--	--	--	--	--	--	.6	.3
23	--	--	.6	--	--	--	--	--	--	--	--	.6	.3
Total	37.3	5.1	23.9	53.7	3.9	9.1	3.4	15.7	12.2	2.5	32.8	199.6	100.0
Percent	18.7	2.6	12.0	26.9	1.9	4.6	1.7	7.9	6.1	1.2	16.4	100.0	--

1/ Includes noncommercial species (shadbush, dogwood, witch hazel, black gum, gray birch, butternut, ironwood) totaling 433 stems under 4.0 inches d.b.h. and 28.9 stems over 4 inches d.b.h.; and commercial species (virginia pine, black birch, black cherry) totaling 40 stems under 4 inches d.b.h. and 3.9 stems over 4 inches d.b.h.

Table 9.--Site II, saw timber: Volume per acre, by species and diameter, and by tree form[1/]

Item	Poor form	Good form	Total		Poor form	Good form	Total	
	Cubic feet	Cubic feet	Cubic feet	Percent	Board feet	Board feet	Board feet	Percent
Species:								
White pine	--	617.5	617.5	30.9	--	2925	2925	43.2
Hemlock	3.3	29.4	32.7	1.7	--	108	108	1.6
Virginia pine	11.6	5.0	16.6	.8	45	15	60	.9
Red oak	76.0	274.2	350.2	17.5	90	1082	1172	17.3
White oak	237.6	501.9	739.5	37.0	502	1676	2178	32.2
Chestnut oak	16.5	.3	16.8	.8	--	--	--	--
Hickory	20.6	27.9	48.5	2.4	19	31	50	0.9
Sugar maple	4.1	3.2	7.3	.4	--	--	--	--
Red maple	31.8	7.3	39.1	2.0	--	13	13	.2
Black birch	2.5	4.8	7.3	.3	--	--	--	--
White ash	35.9	16.1	52.0	2.6	63	31	94	1.5
Black cherry	6.4	--	6.4	.3	--	--	--	--
Butternut	3.9	--	3.9	.2	--	--	--	--
Elm	28.2	6.9	35.1	1.7	122	26	148	2.2
Ironwood	26.3	--	26.3	1.3	--	--	--	--
Noncommercial[2/]	2.5	--	2.5	.1	--	--	--	--
Total	507.2	1494.5	2001.7	100.0	841	5907	6748	100.0
D.b.h.: (Inches)								
4	9.5	3.9	13.4	0.7	--	--	--	--
5	19.1	8.3	27.4	1.3	--	--	--	--
6	41.6	19.3	60 9	3.1	--	--	--	--
7	40.6	35.9	76.5	3.8	--	--	--	--
8	44.8	39.2	84.0	4.2	--	--	--	--
9	57.7	57.4	115.1	5.8	--	61	61	.9
10	55.1	68.6	123.7	6.1	--	55	55	.8
11	82.3	136.3	218.6	10.9	226	452	678	10.1
12	33.3	110.0	143.3	7.2	116	432	548	8.1
13	53.8	101.8	155.6	7.8	205	432	637	9.5
14	35.4	49.6	85.0	4.3	145	212	357	5.2
15	15.5	182.1	197.6	9.9	62	845	907	13.5
16	18.5	168.5	187.0	9.3	87	788	875	13.1
17	--	108.5	108.5	5.4	--	554	554	8.2
18	--	102.4	102.4	5.1	--	469	469	6.9
19	--	129.9	129.9	6.5	--	690	690	10.2
20	--	37.5	37.5	1.9	--	203	203	3.0
21	--	37.1	37.1	1.8	--	210	210	3.1
22	--	47.2	47.2	2.4	--	245	245	3.6
23	--	51.0	51.0	2.5	--	259	259	3.8
Total	507.2	1494.5	2001.7	100.0	841	5907	6748	100.0
Percent	25.3	74.7	100.0	—	12.5	87.5	100.0	--

1/ Burnham, C. F., Ferree, M. J., and Cunningham, F. E. Site class volume tables for merchantable timber in the Anthracite Region of Pennsylvania. Northeast. Forest Expt. Sta. Forest Management Paper 3. 1946.

2/ Includes shadbush, dogwood, witch hazel, black gum, gray birch.

Table 10.--Site I, pole timber: Number of trees per acre, by species and diameter

D.b.h. (Inches)	White pine	Hem-lock	Pitch pine	Red oak	White oak	Chestnut oak	Hick-ory	Red maple	Black birch	Misc.[1/]	Total	Per-cent
1	66	10	--	23	47	--	6	116	6	451	725	62.6
2	35	--	--	18	6	8	--	31	10	133	241	20.8
3	55	--	--	16	39	2	--	12	2	66	192	16.6
Total	156	10	--	57	92	10	6	159	18	650	1158	100.0
Percent	13.5	0.9	--	4.9	7.9	0.9	0.5	13.7	1.5	56.2	100.0	--
4	27.3	0.8	--	7.1	16.8	5.0	1.3	19.9	6.0	4.7	88.9	31.2
5	19.7	--	--	3.4	13.4	4.0	1.3	16.1	4.8	2.0	64.7	22.7
6	12.5	.8	1.7	6.0	7.8	--	1.4	13.9	--	6.6	50.7	17.8
7	10.8	.8	--	3.2	5.9	2.0	.7	4.5	2.0	.8	30.7	10.8
8	5.6	--	0.6	2.8	7.0	2.0	--	2.4	--	.8	21.2	7.4
9	5.0	--	--	4.4	1.8	.8	--	.8	--	--	12.8	4.5
10	1.2	--	--	3.1	.7	--	--	.8	--	--	5.8	2.0
11	.8	--	--	2.4	.8	--	--	.8	--	--	4.8	1.7
12	--	--	--	--	--	--	--	.8	--	--	.8	.3
13	--	--	--	2.4	--	--	--	.8	--	--	3.2	1.1
14	--	--	--	--	--	--	--	.8	--	--	.8	.3
15	.7	--	--	--	--	--	--	--	--	--	.7	.2
Total	83.6	2.4	2.3	34.8	54.2	13.8	4.7	61.6	12.8	14.9	285.1	100.0
Percent	29.4	0.8	0.8	12.2	19.0	4.8	1.6	21.7	4.5	5.2	100.0	--

1/ Includes noncommercial species (shadbush, witch hazel, black gum, ironwood, butternut) totaling 533 stems under 4 inches d.b.h. and 8.1 stems over 4 inches d.b.h.; and commercial species (sugar maple, beech, yellow birch, white ash, yellow poplar, black cherry, aspen) totaling 97 stems under 4 inches d.b.h. and 6.8 stems over 4 inches d.b.h.

Table 11.--Site I, pole timber: Volume per acre, by species and diameter, and by tree form[1/]

Item	Poor form	Good form	Total		Poor form	Good form	Total	
	Cubic feet	Cubic feet	Cubic feet	Percent	Board feet	Board feet	Board feet	Percent
Species:								
White pine	14.2	276.0	290.2	29.1	--	422	422	38.7
Hemlock	--	4.2	4.2	.4	--	--	--	--
Pitch pine	1.1	5.2	6.3	.6	--	--	--	--
Red oak	14.1	215.6	229.7	23.1	--	339	339	31.1
White oak	47.2	120.9	168.1	16.8	--	45	45	4.1
Chestnut oak	2.5	34.8	37.3	3.7	--	--	--	--
Hickory	2.2	8.0	10.2	1.0	--	--	--	--
Red maple	128.7	68.6	197.3	19.9	284	--	284	26.1
Beech	5.0	--	5.0	.5	--	--	--	--
Black birch	4.2	15.4	19.6	1.9	--	--	--	--
White ash	--	.3	.3	--	--	--	--	--
Yellow poplar	--	13.2	13.2	1.3	--	--	--	--
Black cherry	--	1.7	1.7	.2	--	--	--	--
Aspen	--	4.2	4.2	.4	--	--	--	--
Butternut	8.8	--	8.8	.9	--	--	--	--
Ironwood	1.6	--	1.6	.2	--	--	--	--
Noncommercial[2/]	.4	--	.4	--	--	--	--	--
Total	230.0	768.1	998.1	100.0	284	806	1090	100.0
D.b.h.: (Inches)								
4	25.9	18.1	44.0	4.4	--	--	--	--
5	29.2	60.1	89.3	8.9	--	--	--	--
6	37.6	114.7	152.3	15.4	--	--	--	--
7	33.3	118.3	151.6	15.2	--	--	--	--
8	30.4	118.1	148.5	14.9	--	--	--	--
9	--	125.7	125.7	12.6	--	160	160	14.7
10	9.5	63.7	73.2	7.3	--	62	62	5.7
11	11.8	65.2	77.0	7.7	48	222	270	24.7
12	14.3	--	14.3	1.4	62	--	62	5.7
13	17.2	57.4	74.6	7.4	78	221	299	27.5
14	20.8	--	20.8	2.1	96	--	96	8.8
15	--	26.8	26.8	2.7	--	141	141	12.9
Total	230.0	768.1	998.1	100.0	284	806	1090	100.0
Percent	23.0	77.0	100.0	--	26.1	73.9	100.0	--

1/ Burnham, C. F., Ferree, M. J., and Cunningham, F. E. Site class volume tables for merchantable timber in the Anthracite Region of Pennsylvania. Northeast. Forest Expt. Sta. Forest Management Paper 3. 1946.

2/ Shadbush, witch hazel, black gum.

Table 12.--Site II, pole timber: Number of trees per acre, by species and diameter

D.b.h. (Inches)	White pine	Red oak	White oak	Black oak	Scarlet oak	Hick-ory	Red maple	White	Bass-wood	Aspen	Misc.[1/]	Total	Per-cent
1	57	53	40	--	--	20	66	--	13	--	476	725	55.7
2	--	27	50	--	--	7	157	--	--	7	193	441	33.8
3	7	--	57	--	--	--	26	--	--	--	47	137	10.5
Total	64	80	147	--	--	27	249	--	13	7	716	1303	100.0
Percent	4.9	6.1	11.3	--	--	2.1	19.2	--	1.0	0.5	54.9	100.0	--
4	8.7	2.1	29.8	0.5	1.3	4.0	16.9	1.3	1.2	1.4	9.4	76.6	24.4
5	6.0	3.0	34.2	--	1.4	2.0	15.4	1.3	1.3	.5	8.2	73.3	23.3
6	5.9	6.4	26.4	.5	.7	1.1	4.2	1.2	.5	1.0	5.5	53.4	16.9
7	3.5	5.8	19.4	1.8	.7	3.8	1.1	1.3	1.3	--	2.0	40.7	12.9
8	5.0	4.7	8.1	.7	--	2.5	1.0	--	.7	.7	--	23.4	7.4
9	4.2	6.4	5.6	--	.7	1.8	.5	1.3	.7	--	--	21.2	6.7
10	2.7	6.9	3.1	.7	--	2.7	--	.7	--	--	--	16.8	5.3
11	1.0	1.5	.5	--	--	.7	--	--	--	--	--	3.7	1.2
12	1.2	1.1	.5	--	--	--	--	--	--	--	--	2.8	.9
13	1.2	.7	--	--	--	--	--	--	--	--	--	1.9	.6
14	.7	.7	--	--	--	--	--	--	--	--	--	1.4	.4
Total	40.1	39.3	127.6	4.2	4.8	18.6	39.1	7.1	5.7	3.6	25.1	315.2	100.0
Percent	12.7	12.5	40.6	1.3	1.5	5.9	12.4	2.2	1.8	1.1	8.0	100.0	--

1/ Includes noncommercial species (dogwood, crataegus, shadbush, blue beech, witch hazel, sassafras, ironwood) totaling 603 stems under 4 inches d.b.h. and 9.1 stems over 4 inches d.b.h.; and commercial species (hemlock, chestnut oak, sugar maple, pitch pine, beech, black birch, black cherry) totaling 113 stems under 4 inches d.b.h. and 16.0 stems over 4 inches d.b.h.

Table 13.--Site II, pole timber: Volume per acre, by species and diameter, and by tree form[1/]

Item	Poor form	Good form	Total		Poor form	Good form	Total	
	Cubic feet	Cubic feet	Cubic feet	Percent	Board feet	Board feet	Board feet	Percent
Species:								
White pine	44.3	179.7	224.0	19.3	131	499	630	66.6
Hemlock	.9	.3	1.2	.1	--	--	--	--
Pitch pine	2.0	--	2.0	.2	--	--	--	--
Red oak	118.8	173.7	292.5	25.1	113	129	242	25.5
White oak	206.6	162.4	369.0	31.9	19	29	48	5.1
Chestnut oak	1.8	3.1	4.9	.4	--	--	--	--
Black oak	3.4	19.0	22.4	1.9	--	--	--	--
Scarlet oak	9.2	3.7	12.9	1.1	--	--	--	--
Hickory	35.9	63.3	99.2	8.5	27	--	27	2.8
Sugar maple	8.5	.3	8.8	.7	--	--	--	--
Red maple	37.9	12.2	50.1	4.3	--	--	--	--
Beech	3.6	.9	4.5	.4	--	--	--	--
Black birch	2.0	--	2.0	.2	--	--	--	--
White ash	32.9	--	32.9	2.8	--	--	--	--
Basswood	8.8	12.0	20.8	1.8	--	--	--	--
Black cherry	2.4	--	2.4	.2	--	--	--	--
Aspen	1.6	7.2	8.8	.7	--	--	--	--
Ironwood	3.9	--	3.9	.3	--	--	--	--
Sassafras	1.3	--	1.3	.1	--	--	--	--
Total	525.8	637.8	1163.6	100.0	290	657	947	100.0
D.b.h.: (Inches)								
4	22.7	7.6	30.3	2.5	--	--	--	--
5	51.7	19.4	71.1	6.1	--	--	--	--
6	91.3	46.0	137.3	11.7	--	--	--	--
7	109.5	76.0	185.5	16.0	--	--	--	--
8	56.9	97.7	154.6	13.3	--	--	--	--
9	56.0	137.7	193.7	16.7	27	77	104	10.9
10	60.7	138.4	199.1	17.1	--	108	108	11.4
11	39.3	16.1	55.4	4.8	107	63	170	18.0
12	10.0	42.7	52.7	4.6	45	151	196	20.6
13	27.7	17.3	45.0	3.9	111	83	194	20.5
14	--	38.9	38.9	3.3	--	175	175	18.6
Total	525.8	637.8	1163.6	100.0	290	657	947	100.0
Percent	45.2	54.8	100.0	--	30.6	69.4	100.0	--

1/ Burnham, C. F., Ferree, M. J., and Cunningham, F. E. Site class volume tables for merchantable timber in the Anthracite Region of Pennsylvania. Northeast Forest Expt. Sta. Forest Management Paper 3. 1946.

Table 14.--Site I, seedling and sapling: Number of trees per acre, by species and diameter

D.b.h. (Inches)	White pine	Red oak	White oak	Scarlet oak	Red maple	Black birch	Yellow poplar	Black cherry	Aspen	Misc. 1/	Total	Percent
0.25	22	72	132	--	352	6	--	146	4	1538	2272	52.1
1	56	112	208	2	292	16	8	96	4	647	1441	33.0
2	44	62	58	2	80	8	4	26	10	156	450	10.3
3	60	34	12	--	20	2	2	14	8	50	202	4.6
Total	182	280	410	4	744	32	14	282	26	2391	4365	100.0
Percent	4.2	6.4	9.4	0.1	17.0	0.7	0.3	6.5	0.6	54.8	100.0	--
4	60	36	2	4	4	4	2	--	14	10	136	56.7
5	26	12	8	4	2	--	2	--	4	--	58	24.2
6	16	6	2	--	4	--	2	--	2	--	32	13.3
7	4	6	--	--	--	--	--	--	2	--	12	5.0
9	2	--	--	--	--	--	--	--	--	--	2	.8
Total	108	60	12	8	10	4	6	--	22	10	240	100.0
Percent	45.0	25.0	5.0	3.3	4.2	1.7	2.5	--	9.1	4.2	100.0	--

1/ Includes noncommercial species (black gum, crataegus, witch hazel, shadbush, blue beech, dogwood, fire cherry, ironwood, sassafras, chestnut) totaling 2194 stems under 4 inches d.b.h and 8 stems over 4 inches d.b.h.; and commercial species (hemlock, pitch pine, chestnut oak, hickory, beech, yellow birch, gray birch, white ash) totaling 197 stems under 4 inches d.b.h. and 2 stems over 4 inches d.b h.

Table 15.--Site I, seedling and sapling: Volume per acre, by species and diameter, and by tree form[1/]

Item	Poor form	Good form	Total		Poor form	Good form	Total	
	Cubic feet	Cubic feet	Cubic feet	Percent	Board feet	Board feet	Board feet	Percent
Species:								
White pine	7.4	152.0	159.4	49.8	--	64	64	100.0
Red oak	36.6	37.8	74.4	23.3	--	--	--	--
White oak	3.6	14.0	17.6	5.5	--	--	--	--
Chestnut oak	1.0	--	1.0	.3	--	--	--	--
Scarlet oak	1.0	5.8	6.8	2.1	--	--	--	--
Red maple	14.4	3.0	17.4	5.4	--	--	--	--
Black birch	--	2.0	2.0	.6	--	--	--	--
Yellow poplar	--	10.4	10.4	3.2	--	--	--	--
Aspen	2.0	26.6	28.6	8.9	--	--	--	--
Ironwood	2.0	1.0	3.0	.9	--	--	--	--
Total	68.0	252.6	320.6	100.0	--	64	64	100.0
D.b.h. (Inches)								
4	23.0	44.0	67.0	20.9	--	--	--	--
5	12.2	64.4	76.6	23.9	--	--	--	--
6	23.8	73.8	97.6	30.4	--	--	--	--
7	9.0	49.4	58.4	18.2	--	--	--	--
8	--	--	--	--	--	--	--	--
9	--	21.0	21.0	6.6	--	64	64	100.0
Total	68.0	252.6	320.6	100.0	--	64	64	100.0
Percent	21.2	78.8	100.0	--	--	100.0	100.0	--

1/ Burnham, C. F., Ferree, M. J. and Cunningham, F. E. Site class volume tables for merchantable timber in the Anthracite Region of Pennsylvania. Northeast. Forest Expt. Sta. Forest Management Paper 3. 1946.

Table 16.--Site II, seedling and sapling: Number of trees per acre, by species and diameter

D.b.h. (Inches)	White pine	Hem-lock	Red oak	White oak	Chestnut oak	Hick-ory	Red maple	Yellow birch	Gray birch	Aspen	Misc.[1/]	Total	Per-cent
0.25	72	4	80	228	34	38	330	86	158	2	1040	2072	46.0
1	56	4	76	270	54	16	370	26	74	2	858	1806	40.1
2	20	6	46	98	24	14	136	8	20	--	76	448	9.9
3	10	--	44	52	2	--	58	2	6	--	8	182	4.0
Total	158	14	246	648	114	68	894	122	258	4	1982	4508	100.0
Percent	3.5	0.3	5.5	14.4	2.5	1.5	19.8	2.7	5.7	0.1	44.0	100.0	--
4	8	--	16	34	--	--	24	--	--	2	2	86	42.6
5	10	--	10	36	2	--	8	--	--	--	--	66	32.7
6	6	--	4	10	2	--	6	--	--	2	2	32	15.8
7	--	--	--	16	--	--	--	--	--	2	--	18	8.9
Total	24	--	30	96	4	--	38	--	--	6	4	202	100.0
Percent	11.9	--	14.8	47.5	2.0	--	18.8	--	--	3.0	2.0	100.0	--

1/ Includes noncommercial species (dogwood, shadbush, witch hazel, crataegus, blue beech, ironwood, chestnut, sassafras) totaling 1806 stems under 4 inches d.b.h.; and commercial species (scarlet oak, sugar maple, beech, black birch, white ash, basswood, black cherry) totaling 176 stems under 4 inches d.b.h. and 4 stems over 4 inches d.b.h.

Table 17.--Site II, seedling and sapling: Volume per acre, by species, diameter, and by tree form[1/]

Item	Poor form		Good form		Total	
	Cubic feet	Per-cent	Cubic feet	Per-cent	Cubic feet	Per-cent
Species:						
White pine	--	--	22.6	8.6	22.6	8.6
Red oak	12.6	4.8	12.8	4.8	25.4	9.6
White oak	34.6	13.1	118.2	44.8	152.8	57.9
Chestnut oak	7.0	2.6	--	--	7.0	2.6
Scarlet oak	5.8	2.2	--	--	5.8	2.2
Red maple	17.8	6.7	16.8	6.4	34.6	13.1
Aspen	.7	.3	15.0	5.7	15.7	6.0
Total	78.5	29.7	185.4	70.3	263.9	100.0
D.b.h.: (Inches)						
4	19.1	7.2	15.2	5.8	34.3	13.0
5	23.8	9.0	39.8	15.1	63.6	24.1
6	26.2	9.9	54.8	20.8	81.0	30.7
7	9.4	3.6	75.6	28.6	85.0	32.2
Total	78.5	29.7	185.4	70.3	263.9	100.0

1/ Burnham, C. F., Ferree, M. J. and Cunningham, F. E. Site class volume tables for merchantable timber in the Anthracite Region of Pennsylvania. Northeast. Forest Expt. Sta. Forest Management Paper 3. 1946.